

Economic Incentives for On-site Residential Stormwater Control

Office of Research and Development
National Risk Management Research Laboratory
Sustainable Technologies Division
Sustainable Environments Branch

Green Makeover- Retrofitting Sites in Urban Areas to Enrich City Environments

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Economics and Stormwater Control

Objective:

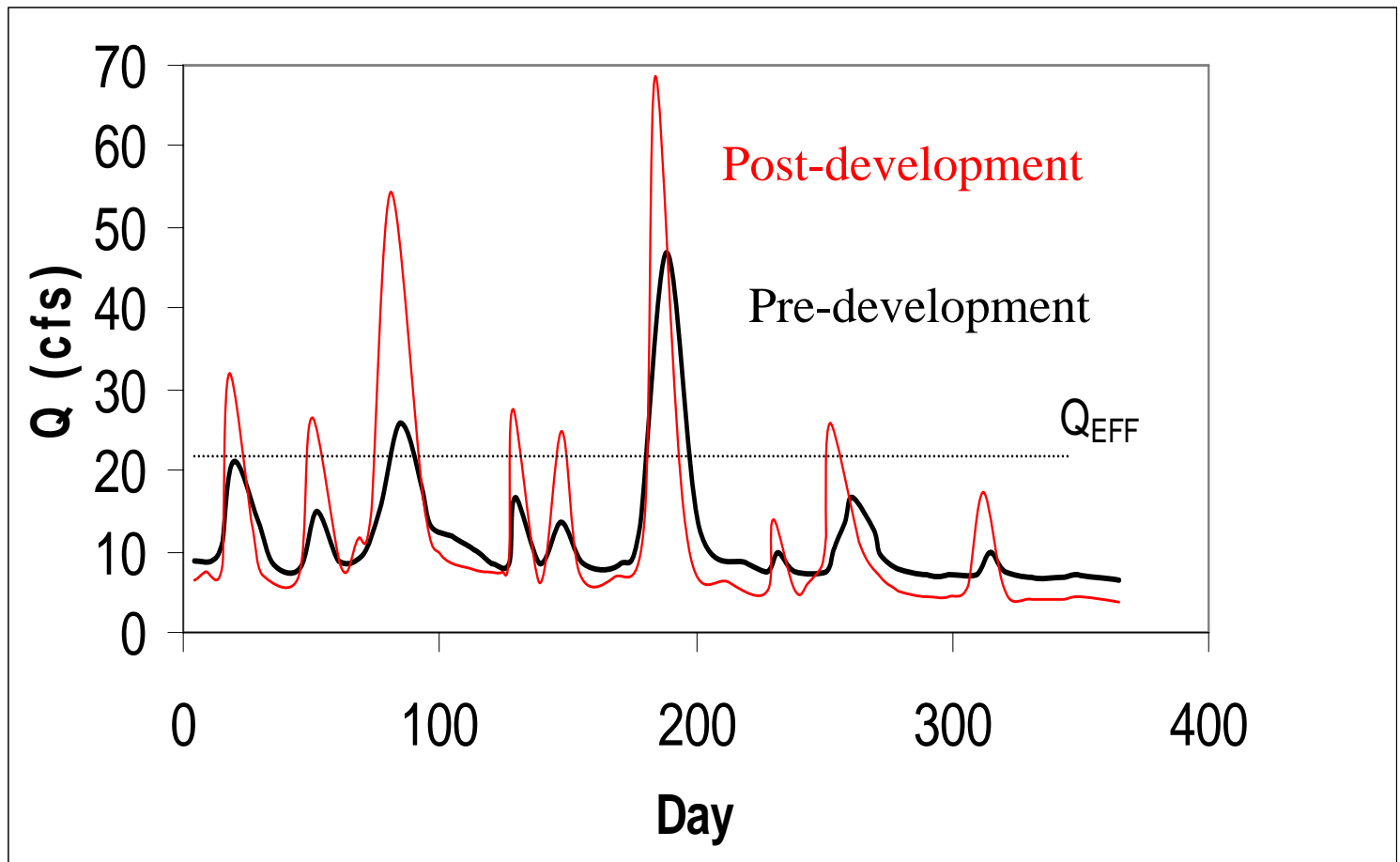
We will test the legal and economic feasibility of installing on-lot stormwater BMPs in an existing subdivision and the hydrologic and ecological response to these BMPs



Research Questions:

- 1) Can a market-based mechanism provide appropriate incentives to install on-lot BMPs throughout this small, Midwestern watershed?
- 2) Will the incentives induce the placement of an adequate number of BMPs, and such that significant hydrologic and ecological improvements are realized in this watershed?

Runoff policy objective: reduce eco-capacity exceedences



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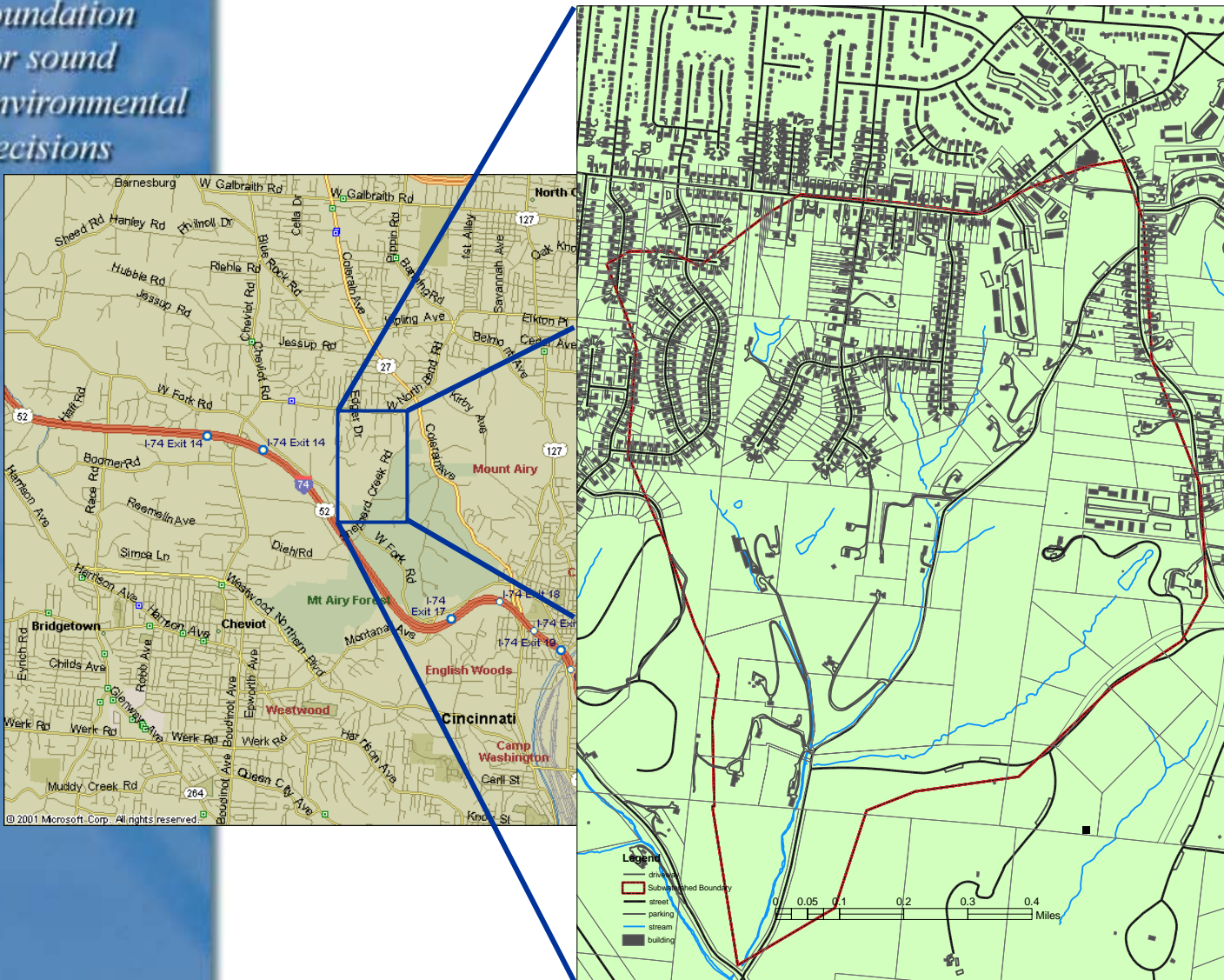
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Pilot Project Area: Shepherd Creek

Figure 1. Impervious Surface in Shepherd Creek



Past Research: 1st Choice

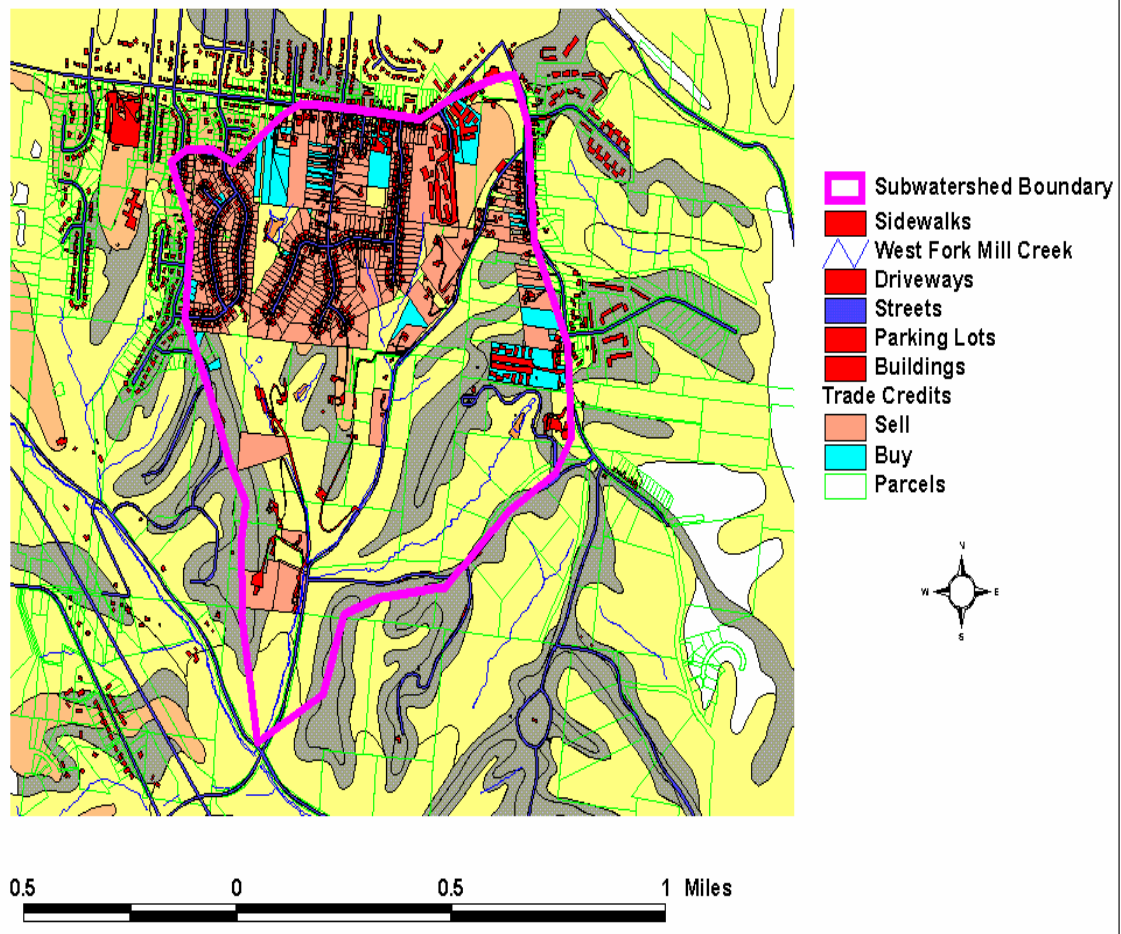
- Tradable Allowances
 - Natural choice
 - Heterogeneous costs
 - Many potential participants
 - Provided Encouraging results
 - Controlled water on-site at a low cost
 - Multiple caveats

How did we see if it would work?

- Modeled pre and post development Runoff using TR-55
- Modeled peoples behavior using BMP cost functions in Excel
- Result: A Map of buyers and sellers on a Parcel-by-parcel Basis

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Allowances \$ 5.00/ft³



From Modeling to Practical Application

Hydrology:

- TR-55 curve number/ event based
- Continuous: SWAT, ANSWERS
- Monitoring/ measurement

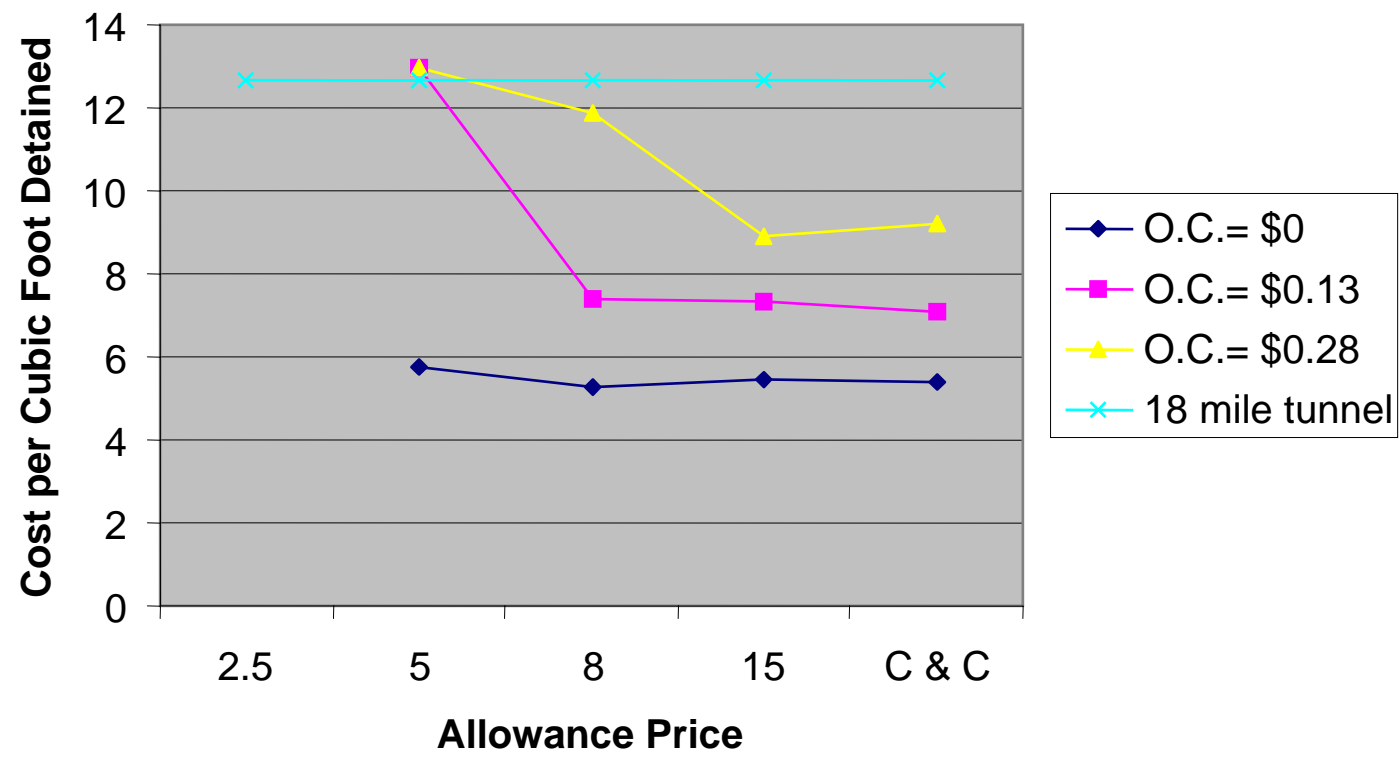
Economics:

- Engineering cost functions
- Modeling and estimating market-based opportunity costs
- Experiments and Auctions
 - WTP or WTA?

Past Research 2nd Choice

- Tradable Allowances with O.C.
 - O.C. measured with Hedonics
 - In many cases still showed lower cost
 - More realistic
- Fee and Rebate with O.C.
 - Similar cost results
 - Fees (and rebates) very high

Per-unit Costs of Runoff Detention
with and without opportunity costs



Per-unit Cost of Detention Using Fee and Rebate						
	Cost per Cubic Foot Detained (to average Homeowner) (\$/ft³)	Quan tity Detai ned (ft³)	Net Utility Revenue (\$)	Cost per Cubic Foot Detained (to average Homeowner) (\$/ft³)	Quantity Detained (ft³)	Net Utility Revenue (\$)
	NO Opportunity Costs			With Opportunity Costs		
Scenario	Command and Control					
No rebate	4.62	82,767	N/A	6.49	82,767	N/A
Scenario	Fee = \$1000					
\$1000 rebate	7.97	38,809	136,000	11.45	27,967	191,000
\$1500 rebate	2.41	61,283	(130,500)	4.04	47,311	(48,000)
\$2000 rebate	(0.55)	71,864	(368,000)	0.48	58,689	(286,000)
Scenario	Fee = \$500					
\$1000 rebate	2.79	38,809	(65,000)	4.26	27,967	(10,000)
\$1500 rebate	(0.87)	61,283	(331,500)	(0.21)	47,311	(249,000)
\$2000 rebate	(3.35)	71,864	(569,000)	(2.94)	58,689	(487,000)
Scenario	Fee = \$1500					
\$1000 rebate	13.15	38,809	337000	18.64	27,967	392,000
\$1500 rebate	5.69	61,283	70,500	8.29	47,311	153,000
\$2000 rebate	2.24	71,864	(167,000)	3.91	58,689	(85,000)

Current Research

- **Challenge – no regulatory “stick.” Water quantity not regulated under CWA (1972)**
 - Tradable credits not tested
 - Only weakly supported by EPA Water Quality Trading Guidance
 - Stormwater fees not tightly tied to excess runoff
- **Potential solution: provide a “carrot” in the form of economic incentives**
 - BMPs will be distributed via a voluntary economic auction
 - Control runoff without necessitating a legal mandate
- **Bids will reflect landowner’s willingness to accept BMPs while considering:**
 - Opportunity cost of land
 - Non-market values
 - Cost effective distribution

1st Step: Experimental Auction

- University Students to “ground-truth”
- Actual residents to calibrate auction
- Experiment begins with a narrative section that includes
 - description of local stormwater problems
 - potential remedies and costs
 - description of proposed policy
- Can be separate video, booklet, or online slide show.

Experimental Auction Computer Screen

EPA STORM WATER RUNOFF EXPERIMENTS

LAST ROUND ACTIVITY


Your bid HAS [NOT] been selected for a small stormwater garden for \$375


Total neighborhood reduction was **52%**

Highest winning bid was **\$420**

Winning noted on image below with ☆

Your lot and neighborhood shown below





TOTAL EXCESS RUNOFF:
25,000 AF

YOUR PARCEL CONTRIBUTION
1,200 AF

{MONTHLY STORMWATER FEE}
\$20

ACCOUNT BALANCE

Starting balance	\$800.00
Storm water control charge	-\$10.00
Ending balance	\$690.00

BIDDING AREA

Select Garden Size:

Runoff Savings

☐ None0

☐ Small300

☒ Medium600

☐ Large900

YOUR BID \$

SUBMIT BID

Auction – economic mechanism to place BMPs

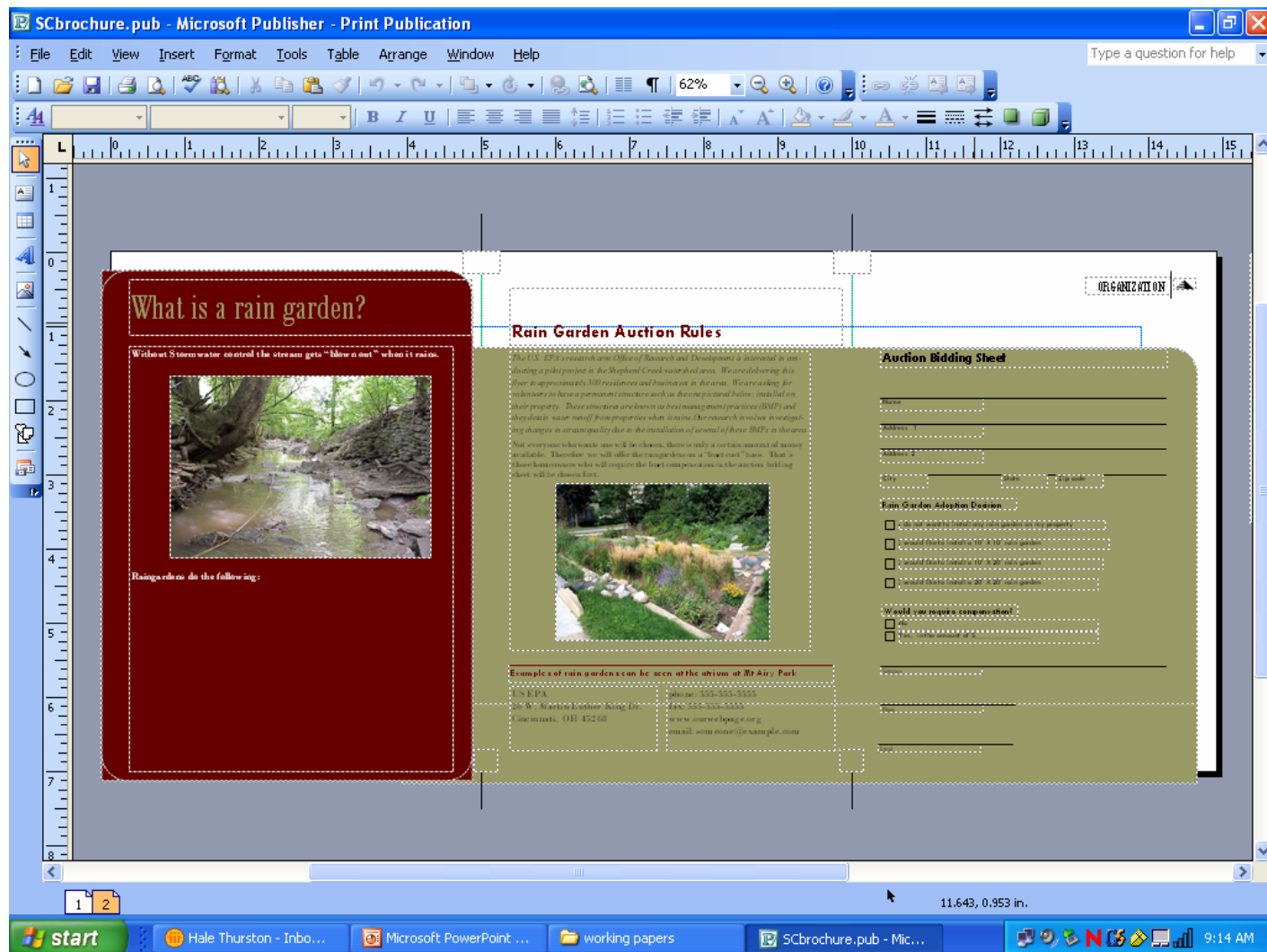
Bids should capture landowner's
willingness-to-accept BMPs

- Cost effective distribution
- opportunity cost of land taken out of other uses
- non-market values residents place on positive changes in stream ecosystem health

Auction – economic mechanism to place BMPs

- Intermediary conducts the Auction
- Sealed bids are ranked in ascending order
- No penalty for not accepting BMPs
- Subsidy will vary by landowner
- Winning bids announced, rain garden BMPs installed
- BMPs are purchased until funds are depleted

Auction, specifics



Real World Applications of Economic Incentives for Stormwater Control

- Portland
- Los Angeles
- Mill Creek
- Australia

Portland, Oregon

- Using Market Forces to Implement Sustainable Stormwater Management
 - US EPA Grant: Collaborative Science and Technology Network for Sustainability
- Determine the feasibility of using a credit trading system to create incentives for property owners to install small-scale, performance-based stormwater systems
- Trading might be coupled with other financial incentives to help landowners reduce effective impervious area
- Diana Bauer, (202) 343-9759, bauer.diana@epa.gov

Los Angeles, California

- BMP implementation strategy is to offer subsidies (financial incentives) to landowners in return for installing and maintaining structural BMPs.
- One method would be to offer reductions in the Los Angeles City stormwater fees to certain land use classes and geographic areas in return for installing structural BMPs.
- Subsidy auctions, whereby landowners would submit bids that would state their required subsidy for constructing a BMP of a given type and volume

Mill Creek, Ohio

- Mill Creek Mill Creek Restoration Project
 - Cooperative agreement with the US EPA
- Explore the potential cost savings that could result from developing stormwater credit and trading programs.
- Develop a pilot study to determine how stormwater credits/trading alternatives might be applied in a selected subbasin of the watershed.
- Evaluate the success of other trading and economic incentives programs.
- *Rivers Quarterly*, Spring 2005, p. 5

Australia: Commonwealth Scientific and Industrial Resource Organisation

- *Catchment Care* –First-price sealed bid procurement auction based tool
 - Proposed sites are assessed in the field and specific environmental value and threat characters associated with the geomorphology, hydrology and remnant vegetation are scored.
 - Bids are called for
 - Bids ranked according to cost effectiveness
 - Most cost effective selected for funding until the funds are exhausted or the reserve price is reached.
 - Landholders contracted to perform the proposed actions: paid according to reaching milestones.
- CSIRO estimates between 23 and 34% more cost effective than the non-competitive system

Research Directions

- Design market mechanism
- Design legal framework to establish market and operations
- Continuous hydrologic modeling
- Trading ratios and “wetspots”
- Opportunity costs for commercial properties
- Experimental auction to ground-truth residential opportunity costs

Internet Resources

- <http://www.americanforests.org/productsandpubs/citygreen/>
- <http://www.ecosystemvaluation.org>
- http://www.forester.net/sw_0207_trading.html
- <http://www.mninter.net/~stack/rain/>
- http://www.clw.csiro.au/publications/consultancy/2005/catchment_care_auction_vol1.pdf